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Crop weather relationship studies under different sowing windows in black gram (*Phaseolus mungo* L.)

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Abstract
The field investigation entitled "Crop weather relationship studies in Black gram (*Phaseolus mungo* L.) under different sowing windows" was carried out during kharif season 2019-20 at Research Farm of College of Agriculture, Nagpur to study the. The experiment was laid out in split plot design with four sowing dates *viz*. D_1 (26th MW), D_2 (27th MW), D_3 (28th MW) and D_4 (29th MW), and three varieties *viz*. V_1 (TAU-1), V_2 (AKU-15) and V_3 (Yashoda-58). Yield attributing character *viz*. number of pod plant^{-1}, weight of dry pod plant^{-1}, grain yield plant^{-1}, test weight, straw yield, biological yield and harvest index recorded maximum in sowing on 26th MW and variety TAU-1. Temperature requirement was maximum in sowing on 26th MW and variety TAU-1 and the influence of relative humidity requirement of sowing on 26th MW and variety TAU-1 were not noticed on yield of crop.

Keywords: Black gram, *Phaseolus mungo* L., varieties and sowing windows

Introduction
Black gram is native to India (Vavilov, 1926) [7]. The progenitor of black gram is believed to be Vigna mungo var. silvestris. Black gram belongs to the family *Fabaceae* and the genus *Vigna*. Only seven species of the genus are cultivated as pulse crops, five Asian species of subgenus *Ceratropis*, *Vigna mungo* (black gram), *V. radiata* (mung bean), *V. aconitifolia* (mothbean), *V. angularis* (Azuki bean) and *V. umbellate* (rice bean) and two African species of subgenus *Vigna*, *Vigna unguiculate* (cowpea) and *V. subterranean* (the Bambara groundnut) (Verdcourt, 1969) [8]. Black gram (*Vigna mungo* L. Hepper) is a member of the Asian *Vigna* crop group. It is a staple crop in the Central and South East Asia however, it is extensively used only in India and now grown in the Southern United States, West Indies, Japan and other tropics and subtropics. Black gram, the 3rd important crop group, was cultivated over an area of 5.44 Mha (kharif + rabi) and recorded a production of 3.56 Mt at productivity level of 655 kg ha^{-1}. This was the highest ever area, production and productivity in this crop. Major contributing states are MP, Rajasthan, AP, UP, Tamil Nadu, Maharashtra, Jharkhand and Gujarat. Black gram crop is also gaining momentum since 2015-16 and there has been phenomenal increase in its coverage. During 2017-18 the crop was cultivated over an area of >50 Lha. The success of this crop was released with a harvest of about 35 Lt at an ever highest yield levels of 352 kg/ha. There is a mention of black gram in Vedic texts such as Kautilya's "Arthashashtra" and "Charak Samhita". The ancient Sanskrit name of black gram was masha. Even today in Punjab, black gram is called mash and in West Bengal, it is called mash kalaya. In all other Indian languages, the name urd is used, which seems to have originated from the Tamil word ulundu. Vigna mungo is the Latin name of black gram (Nene, 2006) [3].

Materials and Methods
A field experiment was conducted to study the "Crop weather relationship studies in Black gram (*Phaseolus mungo* L.) under different sowing windows", during *kharif* season of 2019-2020 at Agronomy Farm, College of Agriculture, Nagpur. Soil of the experimental site was loamy clay in texture, medium in available nitrogen, phosphorous and Sulphur and rich in available potash. Organic carbon content was medium and soil reaction was slightly alkaline. The experiment was laid out in split plot design with 12 treatments with four sowing dates *viz*. D_1 (26th MW), D_2 (27th MW), D_3 (28th MW) and D_4 (29th MW), and three varieties *viz*. V_1 (TAU-1), V_2 (AKU-15) and V_3 (Yashoda-58) replicated thrice.
Three varieties of black gram namely TAU-1, AKU-15 and Yashoda-58 were sown in four different dates to evaluate the optimum sowing date for *kharif*. Black gram. Sowing of black gram was done by manually, keeping 30 cm distance between the rows.

Result and Discussion

Yield attributes and yield

The data given in Table no. 1 revealed that sowing during 26th MW recorded maximum number of pods plant^{-1} (26.44), weight of dry pods plant^{-1} (10.13), grain yield plant^{-1} (7.02) and test weight (42.22 g) were significantly superior over 28th MW and 29th MW, however, it was at par with 27th MW. This might be due to less flower drop and more fruit setting during *kharif* season Similar results were also reported by Ali *et al.* (2014) [1] and Yagoub and Hamed (2013) [10] who inferred these favourable effect of sowing times on grain yield in black gram. Variety TAU-1 recorded maximum number of pods plant^{-1} (25.80), weight of dry pods plant^{-1} (9.47), grain yield plant^{-1} (6.33) and test weight (41.53 g) were significantly superior over Yashoda-58, however, it was at par with AKU-15. This might be attributed due to genetic makeup of cultivar, more number of branches plant^{-1} that helped in production of more number of matured or reproductive pods. These results are close in conformity with Patel and Munda (2001) [4].

The grain yield (9.31 q ha^{-1}), straw yield (13.30 q ha^{-1}) and harvest index (41.17) were significantly highest at sowing during 26th MW over 28th MW and 29th MW, but found at par with 27th MW. This might be due to higher number of pods plant^{-1}, number of seeds plant^{-1}, seed weight plant^{-1} and thousand seed weight. Similar results were also observed by Yadahalli and Palled (2004) [9] and Singh and Kumar (2014) [5]. Among varieties, TAU-1 produced highest grain yield (8.50 q ha^{-1}), straw yield (12.30q ha^{-1}) and harvest index (40.86) were significantly superior over Yashoda-58 and it was at par with AKU-15. This might be due to higher number of pods plant^{-1}, number of seeds plant^{-1}, seed weight plant$^{-1.}$ This is confirmation with the results of Tekale *et al*. (2011) [6] and Singh and Kumar (2014) [5]. Interaction effect between sowing dates and varieties was found to be non-significant.

Economics

The data given in Table no. 1 revealed that sowing on 26th MW recorded maximum Net monetary return (Rs. 48108 ha^{-1}), Gross monetary return (Rs. 66373 ha^{-1}) and B:C ratio (3.63) were significantly superior over 28th and 29th MW, however, it was at par with 27th MW. Similar results were also reported by Kumar *et al.* (2008) [2]. Among the different varieties TAU-1 recorded highest Net monetary return (Rs. 42485 ha^{-1}) and Gross monetary return (Rs. 60750 ha^{-1}) were significantly superior over variety Yashoda-58, however, it was at par with AKU-15. It is also revealed that maximum B:C ratio was recorded in TAU-1 (3.32). Obtained result was also confirmed by matching finding of Kumar *et al.* (2008) [2]. Interaction effect of sowing dates and different varieties on yield and economics was found to be non-significant.

Table 1: Yield attributes and yield of black gram as influenced by various treatments

Sr. No.	Treatments	No. of pods plant^{-1}	Weight of dry pods plant^{-1}	Grain yield plant^{-1}	Test weight	Grain yield q ha^{-1}	Straw yield q ha^{-1}	Harvest index	GMR Rs. q ha^{-1}	NMR Rs. q ha^{-1}	B:C Ratio
A	**Sowing dates**										
	D_1– 26th MW	26.44	10.13	7.02	42.22	9.31	13.30	41.17	66373	48108	3.63
	D_2 – 27th MW	24.82	9.00	5.96	40.76	7.99	11.97	40.03	57503	39238	3.14
	D_3– 28th MW	24.20	8.38	5.16	39.89	7.27	11.03	39.72	52453	34188	2.87
	D_4 – 29th MW	23.62	8.02	4.87	39.27	6.60	10.13	39.45	47753	29488	2.61
	S.E. (m) ±	0.52	0.38	0.33	0.52	0.41	0.51	-	2715	2715	-
	C.D. at 5%	1.80	1.34	1.14	1.81	1.44	1.76	-	9394	9394	-
B	**Varieties**										
	V_1– TAU-1	25.80	9.47	6.33	41.53	8.50	12.30	40.86	60750	42485	3.32
	V_2– AKU-15	24.97	8.83	5.85	40.23	7.81	11.70	40.03	56208	37990	3.07
	V_3 – Yashoda-58	23.55	8.35	5.07	39.83	7.07	10.83	39.49	51105	32840	2.79
	S.E. (m) ±	0.38	0.23	0.21	0.45	0.24	0.38	-	1503	1503	-
	C.D. at	1.16	0.71	0.62	1.36	0.73	1.14	-	4510	4510	-
C	**Interaction**										
	S.E. (m) ±	0.77	0.47	0.42	0.90	0.48	0.76	-	3006	3006	-
	C.D. at 5%	NS	NS	NS	NS	NS	NS	-	NS	NS	-
	G. M.	24.77	8.88	5.75	40.39	7.79	11.60	40.10	56021	37763	3.06

Conclusion

Sowing of black gram during 26th MW and variety TAU-1 recorded significantly high yield attributing characters *viz.* number of pods plant^{-1}, weight of dry pods plant^{-1}, grain yield plant^{-1}, test weight, grain and straw yield plant^{-1} and harvest index. Sowing of black gram during 26th MW and variety TAU-1 recorded significantly highest Gross monetary return, Net monetary return and B:C ratio.

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